

Chapter 3 : AFRTS Satellite Networks

American Forces Radio and Television Service (AFRTS) uses a combination of domestic and international satellites to deliver radio and television programming and data products to its audience around the world. Two satellite networks are in place: the AFRTS Satellite Network (SATNET) and the AFRTS Direct-To-Sailor Satellite Network (DTS). SATNET is made up of a C-Band satellite service to the Atlantic (AOR) Ocean Region, and Ku-Band satellite services, which are available in the greater European and Southwest Asia theatres, and Japan and Korea. DTS satellite services are broadcast on C-band and are available in three service areas: the Pacific Ocean Area (POR), the Atlantic Ocean Area (AOR), and the Indian Ocean Region (IOR). The network operating system for the SatNet network is an MPEG-2 video compression system broadcasting multiple channels of television, radio and data services. The DTS network uses a similar system using MPEG-1 video compression. The program material for the domestic and international legs of the SATNET C-band Service and the DTS networks originate from the AFRTS Broadcast Center (AFRTS-BC) located at March Air Reserve Base east of Los Angeles, California. Programming for the European leg of the network, known as SATNET Ku-band Service, originates from the AFRTS-BC with regional programming added by AFN Europe located in Frankfurt, Germany. Programming for the Pacific Ku band service also originates from AFRTS-BC with regional programming by AFN Pacific located in Tokyo Japan.

Introduction to PowerVu

AFRTS uses a digital video compression system that allows for the delivery of multiple channels of programming simultaneously over each of the satellite networks described above. The Scientific Atlanta PowerVu system is used by AFRTS and was designed to conform to the Moving Picture Experts Group (MPEG) and European Digital Video Broadcasting (DVB) standards for digital video compression. PowerVu is a full MPEG digital video compression system which not only provides AFRTS with a flexible operating system for multiple channel transmission, it also provides state-of-the-art network and subscriber management capabilities combined together into one satellite transmission stream. PowerVu also provides for encryption, which ensures that only authorized users have access to AFRTS programming. One of the most powerful capabilities of PowerVu is the Virtual Channel feature, which allows AFRTS-BC to create various programming channel combinations to suit audience needs. Other features include the use of error correction, which helps to overcome noisy satellite transmissions.

Historically, television broadcasting has placed a great demand on satellites, particularly in terms of bandwidth and transmit power. The television signal contains an extraordinary amount of electronic information, all of which needs to be received by the viewer's television set in order to recreate acceptable pictures and sound. There is a direct relationship between the amount of electronic information transmitted (more is better) and the bandwidth and power used for

that transmission. Simply put, the information transmit rate is directly proportional to the bandwidth required and, assuming all other factors being equal, the bandwidth is directly proportional to the amount of power required. The size of the required receive antenna is inversely proportional to the effective isotropic radiated power (EIRP) from the satellite. The AFRTS system takes advantage of the relationship between bandwidth and power in a couple of ways.

First, the system uses video compression technology to squeeze multiple television channels into the same transmitted channel bandwidth as was used by the previous AFRTS transmission scheme for a single channel. Secondly, by reducing the information rate but not reducing the power means, particularly in the case of DTS, that there is more power available for each bit of transmitted information. In more technical terms there is a higher ratio of energy per data bit in the transmit data stream and this translates ultimately into a reduction in the size of the receive antenna required to produce acceptable pictures and sound.

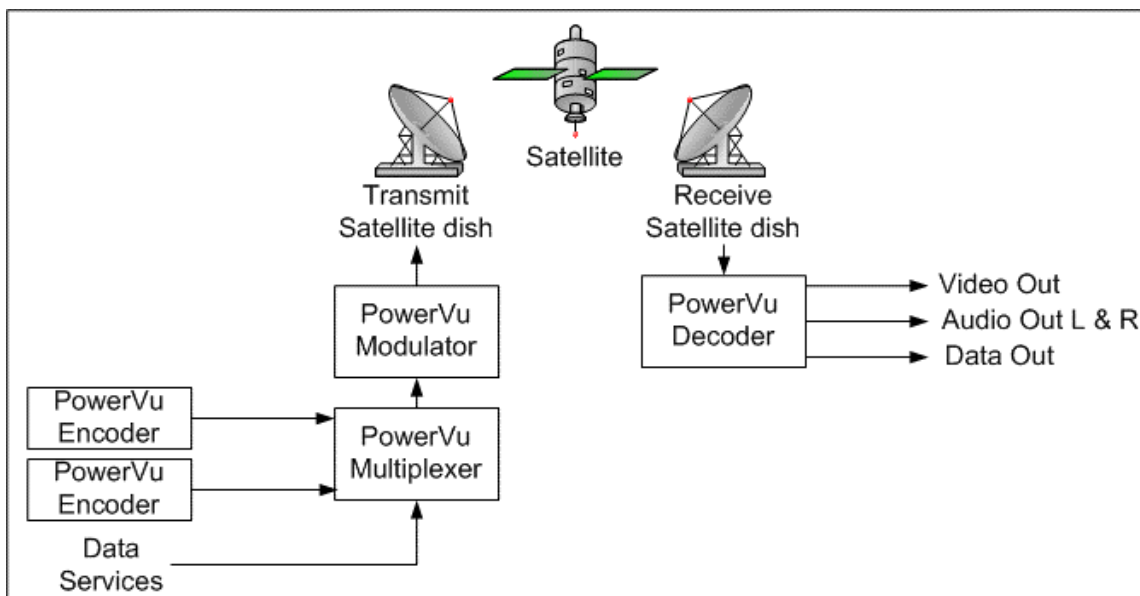


Figure 3-1 Block level system diagram

Figure 3-1 shows a simplified block diagram of the PowerVu system of MPEG-2 encoders, multiplexer, transmission, and decoding equipment. Analog video and audio signals are presented to PowerVu encoders where they are converted into digital signals and then compressed into an MPEG format. The compression process removes digital bits that are either not needed by the PowerVu system, or are redundant picture and sound information that PowerVu temporarily removes during satellite transmission and then reinserts during the process of restoring the original signals in the compression decoder. In the AFRTS system as many as eight encoders feed a single PowerVu multiplexer which performs several functions including combining of multiple encoder signals, addition of utility data to the combined data stream, signal encryption or scrambling, and processing of program guide information. The multiplexer's output signal is then modulated and amplified for transmission over a satellite link. At a satellite downlink, a PowerVu Integrated Receiver Decoder (IRD) performs all of the

necessary functions to receive, demodulate, and decode the video, audio, and data signals from the single MPEG data stream.

AFRTS employs encryption and scrambling in its PowerVu operating system to ensure that only authorized viewers are able to receive programming. The PowerVu system not only allows AFRTS to individually control both the general overall authorization of compression decoders, that is controlling whether or not a decoder can receive and decode the MPEG signal, but it also provides for the control of individual services available to the decoder. For example, AFRTS can blackout an individual channel or program authorization to a single decoder if the need ever arises.

Once the picture and sound information are converted into MPEG digital bit streams by the PowerVu encoders, it is possible to mix and match video data from one source with audio data from another to create a totally unique channel. This is the basic concept of PowerVu virtual channels and it is a capability that AFRTS has taken advantage of in the design of the various satellite networks. The operational and technical needs of a cable television head end operator may differ significantly, for example, from that of an AFRTS affiliate broadcast station. As was mentioned earlier, the PowerVu compression decoders can be outfitted with a wide range of options such as up to four channels of stereo radio programming. The PowerVu system allows AFRTS the ability to match, for example, entertainment television programming which has been timed for a particular geographic region with similarly programmed radio services. PowerVu also allows for the manipulation of the utility and high-speed data programming by means of the virtual channel feature.

The MPEG standard was designed with a degree of extensibility, which is the ability to add services to the transmission signal other than television and radio programming. One of these services that PowerVu provides and AFRTS is taking advantage of is utility data service. The utility data feature of PowerVu has been designed to be very simple and can be thought of as a data pipe. A PC or other data source simply transmits the serial data into the multiplexer by way of a communications program, and it is available without modification at the decoder as though it had been transmitted through a computer network cable.

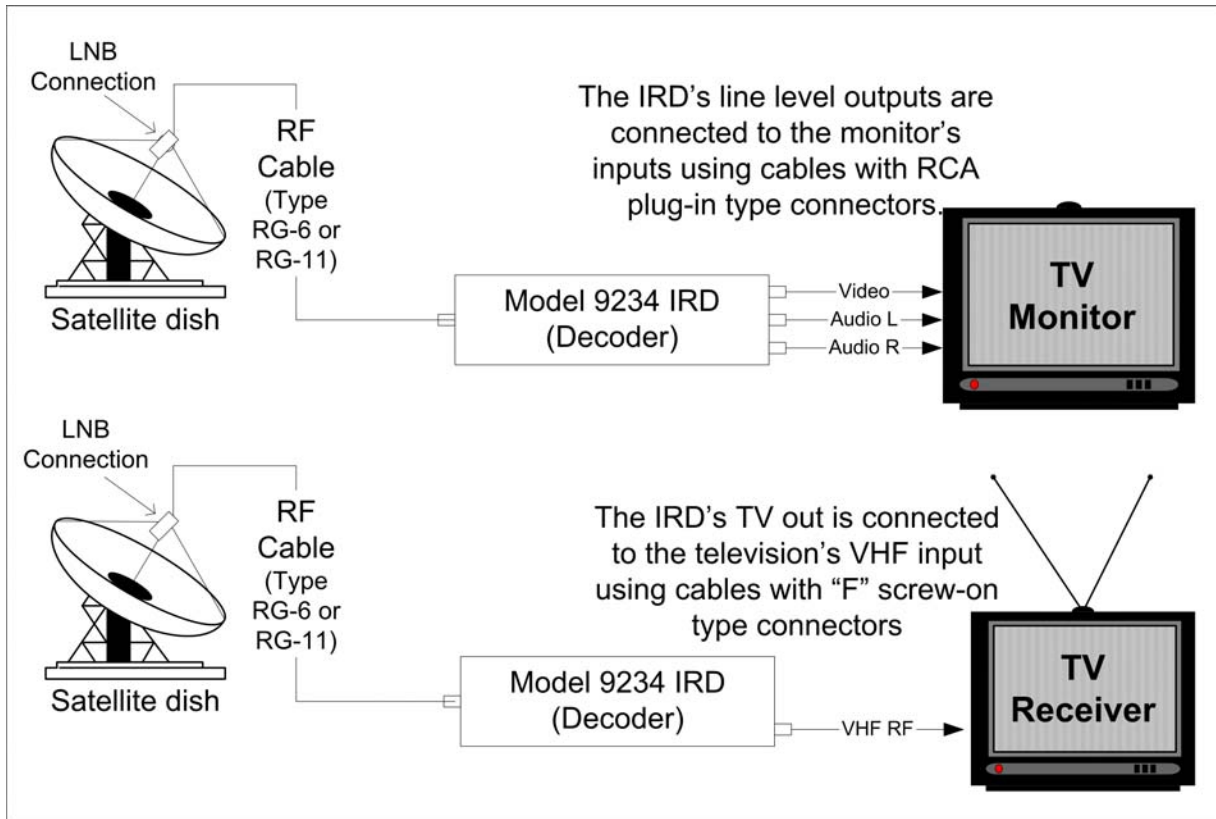


Figure 3-2 Connecting an IRD to a monitor or TV receiver

The integrated receiver/decoder (IRD) is a primary link to AFRTS satellite broadcasts. Without a properly authorized and configured IRD it is not possible to use or access any of the television or radio programming or data services provided by AFRTS. The compression decoder is designed to receive and decode the satellite signal and then to demodulate, decompress, and decrypt the available and authorized programming services. Figure 3-2 shows typical block diagrams of the connection between a satellite antenna, a PowerVu IRD, and the users own equipment. All PowerVu IRDs are designed to be connected to a satellite Frequency (RF) signal that is in the L-band frequency range between 950 and 1450 MHz. However, the satellite technology in use today does not allow for transmissions back to earth in that frequency range. Users wishing to receive any of the AFRTS satellite signals directly must outfit their antennas with a Low Noise Block Converter Amplifier, or LNB. The signal from the LNB output is connected directly to, in most cases, the input of the IRD and, as Figure 3-2 shows, the video and audio outputs from the IRD are connected directly to the users equipment. The user then simply changes the IRD to a virtual channel, and provided the IRD is authorized by AFRTS, receives the television and radio services of that virtual channel much like any cable or direct-to-home television service in the world.

SATNET C-Band Satellite and Japan/Korea Ku-band Services

AFRTS-BC compiles the video and audio programming from the major US television and radio networks such as ABC, CBS, NBC, FOX and ESPN. Data

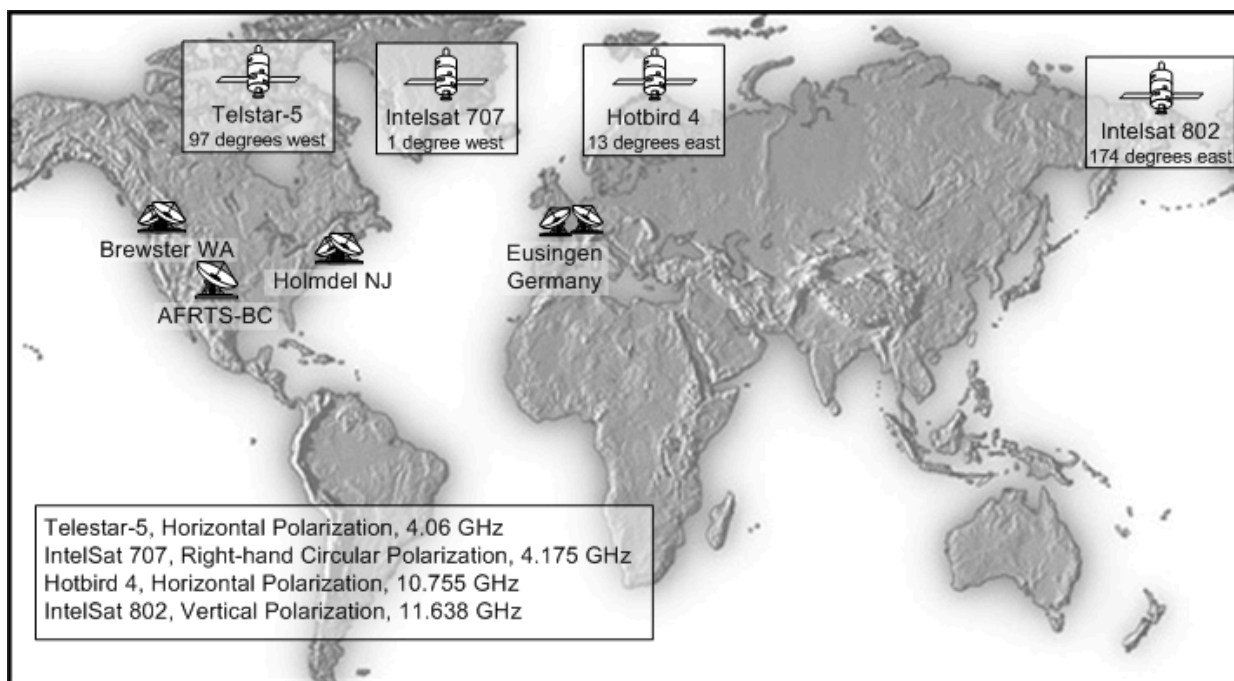


Figure 3-3 AFRTS SATNET network diagram

programming is supplied to AFRTS-BC from a variety of DoD and commercial

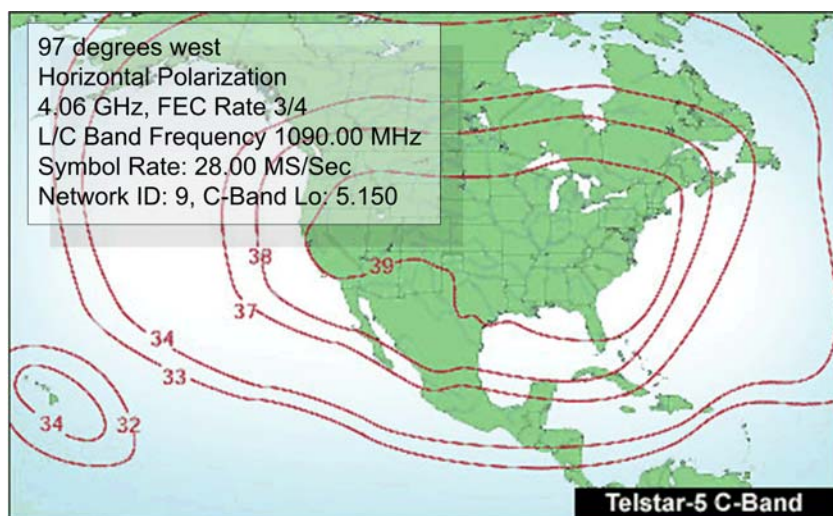


Figure 3-4 AFRTS SATNET Telstar 5 footprint

sources. All of this programming is then electronically manipulated into the unique SATNET television, radio, and data channels that are then transmitted around the world. Figure 3-3 shows the overall SATNET architecture. The domestic and international SATNET C-band

feeds originate at AFRTS-BC where the signal is up linked to Telstar-5 located at 97° west. The satellite feed from Telstar-5 is received by AFRTS customers located within the domestic satellite footprint at locations. Refer to Figure 3-4 for the satellite signal coverage from Telstar-5.

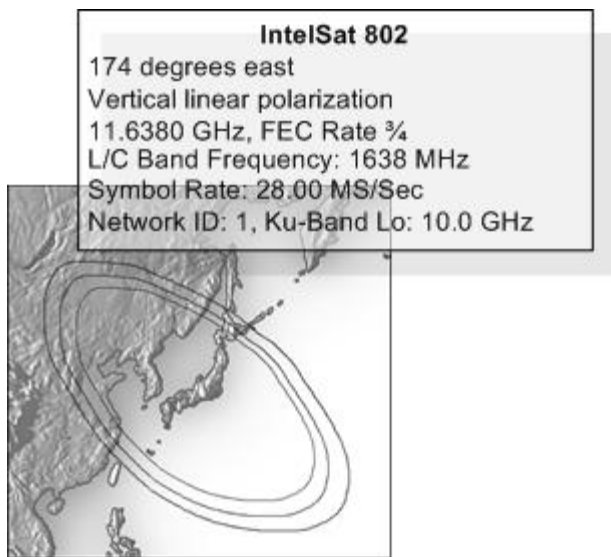


Figure 3-6 AFRTS SATNET INTELSAT 802 footprint

Also receiving the domestic satellite feed are two international satellite gateways: the West Coast gateway located at Brewster, Washington; and the East Coast gateway located at Holmdel New Jersey. The gateway at Brewster transmits the SATNET Ku-band service to the international satellite located at 174° East for Direct-To-Home (DTH) service to both Japan and Korea audiences. Refer to Figure 3-5 for the satellite footprint for this satellite. Similarly, the gateway in Holmdel transmits the same SATNET C-band service to the international satellite located at 1° West (359° East); its footprint

can be found on Figure 3-6. Pacific Ocean areas not served by the Direct-to-Home service in Japan and Korea can receive DTS signals from an international satellite at 180 degrees East.

Virtual Channel Guide

Appendix A provides the virtual channel information for the SATNET C-band Service. Appendix D provides additional satellite parameters.

The AFN News channels provides 24 hour a day timely news, news features, business and military news as gathered from the major networks.

The AFN Sports channel features sporting events, sporting news, and feature sports programming.

The AFN entertainment television channels are similar to mainstream commercial television in terms of look, but surpass it in terms of content, featuring the best of American television. Each entertainment channel is programmed and scheduled to best serve a geographic audience; AFN Atlantic is programmed for the European audience; AFN Pacific for the Asian and Western Pacific audiences; and AFN Korea for the audience in Korea.

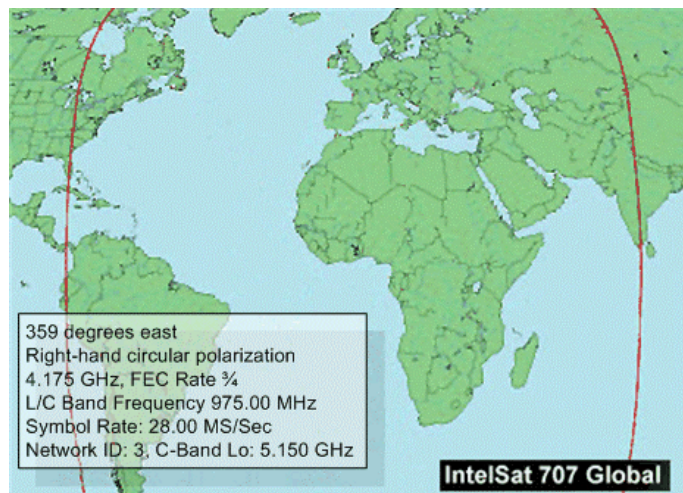


Figure 3-5 AFRTS INTELSAT 707

The Spectrum channel is made up of programming which features movies, the best of Public Broadcasting Service, Arts & Entertainment (A&E), Discovery Channel, History Channel, and classic series and cartoons. This service is packaged into eight-hour segments that are shown three times, each eight-hour segment presenting an alternative family oriented program for each major time zone during prime time.

The Pentagon channel is produced by the AFRTS NewsCenter in Washington DC and provides extended coverage of many events that the major news networks may not necessarily cover in their entirety. The Pentagon Channel's current daily schedule includes live events such as Pentagon Press and Operational Briefings, Secretary of Defense town hall meetings, Central Command Press and Operational Briefings, State Department and White House briefings, Capitol Hill testimony by Defense officials and other relevant events available from the National Network Pool.

Multiple types of radio programming are available on SATNET: The AFN Uninterruptible Voiceline radio service includes news, commentary, and special feature radio programming from a variety of U.S. commercial radio networks including AP, UPI, and CNN all on a 24-hour basis. The AFN Voiceline radio service offers the same news and commentary programming but breaks away to provide alternative live sports programming at various times. Approximately two to five games are provided Monday through Friday, and five to seven during the weekends. Playoff and championship series will increase this number slightly. Music radio services include jazz, classical and information programs from National Public Radio; adult contemporary; urban contemporary; top-40, and Pure Gold "oldies". In addition there is a mainstream country service, adult rock, and Z-Rock (hard rock).

Data products are transmitted over SATNET using PowerVu utility data channel. Refer to chapter 7 of this handbook for information on data services provided by AFRTS.

SATNET European Ku- Band Satellite Services

The American Forces Network (AFN-Europe) affiliate station located in Frankfurt, Germany downlinks the SATNET C-Band service and adds local European News and Information to

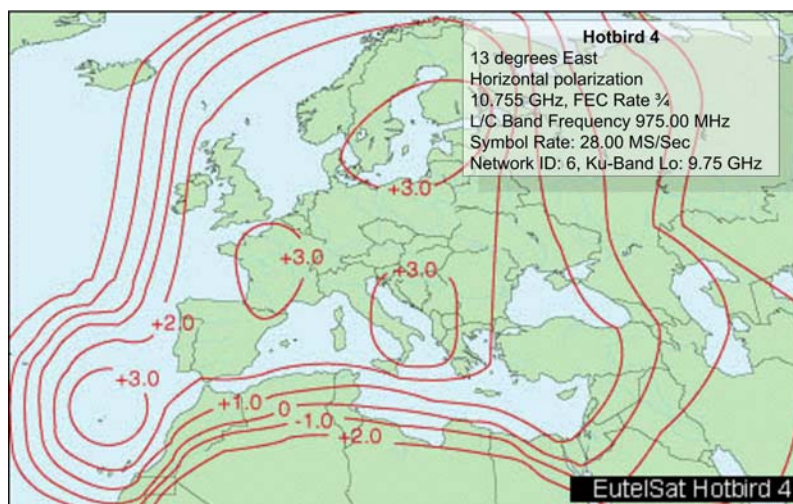


Figure 3-7 AFNE Hotbird 4

create a unique European version of SATNET referred to as the AFN Europe Service.

The AFN Europe Ku-band service originates at AFN-E where the signal is fed over a high-speed fiber optic data channel to a commercial satellite teleport located at Usingen, Germany. At Usingen, the AFN Europe Service is transmitted to a European Satellite (Hotbird 4) located at 13° East for broadcast to Europe and Southwest Asia. Refer to figure 3-7 for the satellite coverage area.

Virtual Channel Guide

This section provides virtual channel information for the AFN Europe Service. At the present time AFN-E programs seven American Forces Network (AFN) television services that are transmitted over the SATNET C-band Service. (See Appendix A)

The AFN News channels provides 24 hour a day timely news, news features, business and military news as gathered from the major networks.

The AFN Sports channel features sporting events, sporting news, and feature sports programming.

The AFN Entertainment television services are similar to mainstream commercial television in terms of look. Each Entertainment service is programmed and scheduled to best serve a geographic audience: AFN Atlantic is programmed to suit the European audience.

The Spectrum service is made up of family oriented programming which features the best of Public Broadcasting Service, Arts & Entertainment (A&E), Discovery Channel, History Channel, and classic series and cartoons. This service is packaged into eight-hour segments that are shown three times, in a 24-hour period.

The Pentagon channel is produced by the AFRTS NewsCenter in Washington DC and provides extended coverage of many events that the major news networks may not necessarily cover in their entirety. The Pentagon Channel's current daily schedule includes live events such as Pentagon Press and Operational Briefings, Secretary of Defense town hall meetings, Central Command Press and Operational Briefings, State Department and White House briefings, Capitol Hill testimony by Defense officials and other relevant events available from the National Network Pool.

Multiple types of radio programming are available on the Ku-Band SATNET: The AFN Uninterruptible Voiceline radio service includes news, commentary, and special feature radio programming from a variety of U.S. commercial radio networks including AP, UPI, and CNN all on a 24-hour basis. The AFN Voiceline radio service offers the same news and commentary programming but breaks away to provide alternative live sports programming at various times. Approximately two to five games are provided Monday through Friday, and five to seven during the weekends. Playoff and championship series will increase this number slightly. Music radio services include jazz from National Public Radio,

adult contemporary from Westwood One Radio Networks, The Tom Joyner Morning Show featuring urban contemporary, “Jamz” urban contemporary, and Pure Gold from ABC Radio. In addition there is the mainstream country service from Westwood One Radio “country,” as well as the two AFN Europe originated radio services.

AFRTS Direct-To-Sailor Satellite Network (DTS)

The AFRTS DTS satellite network is a digital video compression system capable of providing video, audio, and data programming to AFRTS viewers around the world including sailors and Marines at sea underway aboard US Navy ships and Pacific Ocean areas not serviced by the Direct to Home service in Japan and Korea. The transponders on the three international DTS satellites are supplying global, premium beam service at an effective isotropic radiated power (EIRP) level of 29.0 dBW (at beam edge). All three satellites transmit a left hand circularly polarized (LHCP) signal, but each has its own dedicated C-Band (3.7 GHz to 4.2 GHz) downlink frequency. The network operating system uses MPEG-1 video compression technology to broadcast three video channels with their associated audio, additional stereo and monaural radio channels, and a utility data channel. All of the program material for these channels originates at the AFRTS Broadcast Center (AFRTS-BC) located at March Air Reserve Base near Los Angeles, California.

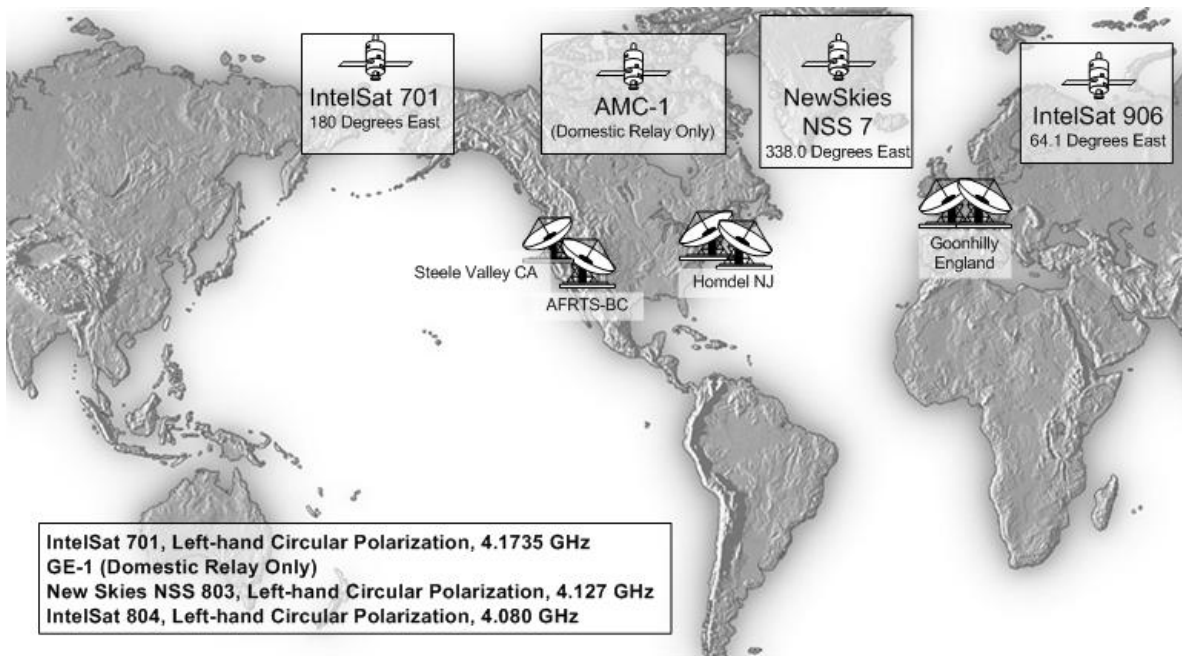


Figure 3-8 DTS Satellite network diagram

DTS Satellite Network Architecture

AFRTS-BC compiles the television and radio programming and data from the major US television and radio networks such as ABC, CBS, CNN, FOX, and

NBC. This material is then configured into the unique DTS television, radio, and data channels that are then transmitted around the world over the AFRTS DTS satellite network. Figure 3-8 shows the overall DTS satellite network which

includes a constellation of one domestic and three international satellites

broadcasting the DTS signal to the three ocean regions: Atlantic Ocean Region (AOR), Indian Ocean Region (IOR), and Pacific Ocean Region (POR). The signal path to these satellites starts at AFRTS-BC where two independent networks are established, a DTS-POR network and a separate DTS-AOR/IOR network.

The DTS-POR signal originates at AFRTS-BC where it is transmitted by a fiber optic high capacity data channel (45 Mbps, DS-3) to the West Coast international uplink site which relays the signal to an INTELSAT satellite located over the center of the POR service area. Refer to figure 3-9 (180° Pacific Ocean Region



Figure 3-9 IntelSat 701 Pacific Ocean

(POR) satellite footprint map).

The DTS AOR/IOR signal also originates at AFRTS-BC but unlike the POR signal is up linked directly to a domestic satellite that provides the signal to the

East Coast international uplink site. The

East Coast uplink site transmits to the NEW SKIES 7 satellite to provide the signal to the AOR service area (Figure 3-10). Located within the DTS-AOR service area is the European satellite relay facility at Goonhilly, UK that receives the AOR signal and relays it to another INTELSAT satellite located in the IOR service area (Figure 3-11). (**Note:** The DTS domestic satellite link was designed for connectivity purposes to very large antennas and is not useable to provide service for shipboard customers.)



Figure 3-10 New Skies NSS-7 Atlantic Ocean and Mediterranean Sea

Virtual Channel Guide

This section provides channel information for the two DTS networks. Appendix A provides the virtual channel information for the all service networks.

At the present time AFRTS programs three television services that are transmitted over each of the two DTS Satellite Networks.

The AFN News channels provides 24 hour a day timely news, news features, business and military news as gathered from the major networks.

The AFN Sports channel features sporting events, sporting news, and feature sports programming.

The AFN entertainment television services are similar to mainstream commercial television in terms of look, but surpass it in terms of content, featuring the best of American television. Each entertainment service is programmed and scheduled to best serve a geographic audience. AFN Pacific is transmitted over the DTS-POR system and is timed for the Japan time zone audience; AFN Atlantic is transmitted over both the DTS-AOR and DTS-IOR systems and is scheduled for an audience in the Central European time zone.



Figure 3-11 IntelSat 906 Indian Ocean and Persian Gulf

Two types of radio programming are available on the DTS system: AFN Voiceline and AFN stereo radio channels. AFN Voiceline radio services include news, commentary, and special feature radio programming from a variety of U.S. commercial radio networks including AP, UPI, and CNN. As the name implies, the AFN Uninterruptible Voiceline offers this type of

programming on a 24-hour basis. The AFN Voiceline offers same news and commentary programming but breaks away to provide alternative live sports programming. Approximately two to five games are provided Monday through Friday, and five to seven during the weekends. Playoff and championship series will increase this number slightly. The two stereo radio channels have been designed specifically for use with the DTS system. Channel one is a mix of jazz from National Public Radio, adult contemporary from Westwood One Radio Networks, The Tom Joyner Morning Show featuring urban contemporary, "Jamz" urban contemporary, and Pure Gold from ABC Radio. Channel two is a mix of mainstream country from Westwood One Radio "country," adult rock and roll from Westwood One Radio, and Z-Rock (alternative rock) from ABC Radio.

Public affairs data products are transmitted over the DTS system using the 128 kbps utility data channel. These include *Stripes* Newspaper, *Early Bird*, *Navy News Wire Service*, and the *New York Times* Fax. Additional data products will be added as they become available.

See appendixes B and D for additional technical reference on both SATNET and DTS signals.